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Frequency-stabilized cavity ring-down spectroscopy (FS-CRDS)

DAVID LONG, Division of Chemistry, California Institute of Technology, Pasadena, CA, DANIEL HAVEY, Process Measurements Division, National Institute of Standards and Technology, Gaithersburg, MD, MITCHIO OKUMURA, Division of Chemistry, California Institute of Technology, Pasadena, CA, CHARLES MILLER, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, JOSEPH HODGES, Process Measurements Division, National Institute of Standards and Technology, Gaithersburg, MD — FS-CRDS differs from traditional single mode, cw-CRDS by actively stabilizing the optical cavity length through the use of a co-resonant reference beam. This length stabilization in turn stabilizes the cavity's free spectral range (FSR). During a spectral scan, the laser frequency is stepped between successive TEM₀₀ modes, resulting in an extremely linear and stable spectral frequency axis. This stability leads to a short term noise equivalent absorption coefficient of 2.5×10^{-10} cm⁻¹ Hz^{-1/2}. Long-term averaging is also possible, due to the stable frequency axis, allowing for a detection limit of 1.8×10^{-11} ${\rm cm}^{-1}$, corresponding to a line intensity of 2.5×10^{-31} cm/molec. Using FS-CRDS we have quantitatively measured nine ultraweak electric quadrupole transitions in the O_2 A-band having intensities of 3×10^{-30} to 2×10^{-29} cm/molec. Eight of these transitions had not previously been observed.

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